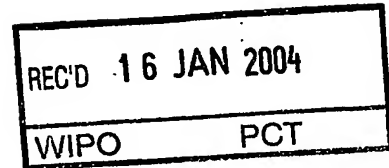


PCT/NZ03/00274



CERTIFICATE

This certificate is issued in support of an application for Patent registration in a country outside New Zealand pursuant to the Patents Act 1953 and the Regulations thereunder.

I hereby certify that annexed is a true copy of the Provisional Specification as filed on 20 December 2002 with an application for Letters Patent number 523324 made by Wellington Drive Technologies Limited.

Dated 6 January 2004.

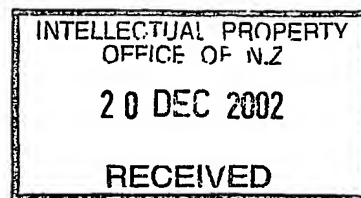
A handwritten signature in cursive script that reads "Neville Harris".

Neville Harris
Commissioner of Patents, Trade Marks and Designs



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NEW ZEALAND

Patents Act 1953

PROVISIONAL SPECIFICATION

Title *Bobbins for toroidal core wound continuously*

We, *Wellington Drive Technologies Limited*

Nationality: *New Zealand*

Address: *13 William Pickering Drive, North Harbour, Auckland*

do hereby declare this invention to be described in the following statement :

Electrodynamic machine

This invention relates to toroidally wound electrodynamic machines.

5 Toroidally wound electrodynamic machines are by their very nature relatively difficult to construct, in that complex equipment is required to form the windings about a circular electromagnetic core. To overcome this difficulty some manufacturers have wound the coils onto bobbins using simple winding equipment, and the wound bobbins are later introduced onto a split magnetic core. The two ends of the wires of each coil must then be electrically connected in a correct relationship with other coils forming a ring of electromagnets. This
10 has been accomplished previously by connecting each wire to a circular printed circuit board. The conductive paths on the printed circuit board being designed to provide the required connections of the coils in the group. However this process can be complex and expensive.

15 It is therefore an object of the present invention to provide a toroidally wound electrodynamic machine constructed using a series of pre-formed windings which are created in an electrically continuous manner during the winding process or which will at least provide the public with a useful choice.

20 Accordingly, the invention may broadly be said to consist in a toroidally wound electrodynamic machine wherein all of the coils are pre-wound onto bobbins mounted on a single former using a continuous wire for each phase, winding only one coil of each phase at a time and extending the same wires to begin each successive new set of coil windings.

Preferably the bobbins interfit, using an interference fit male and female method for example.

25 Alternatively the bobbins may be manufactured jointly, as a single part or multiple inter-fitting parts which may be deformed into a toroid after winding.

Preferably the bobbins are provided with pathways to support the wires as they pass from one winding to another.

Preferably the assembly of pre-wound and electrically connected bobbins can be easily formed into a circular shape.

- 5 Preferably the circular assembly of pre-wound and electrically connected bobbins can be positioned about a circular core of magnetic material.

Preferably the toroidally wound electrodynamic machine is an electric motor.

- 10 The invention may also broadly be said to consist in the parts, elements and features referred to or indicated in the specification of the application, individually or collectively, and any or all combinations of any two or more of the parts, elements or features, and where specific integers are mentioned herein which have known equivalents, such equivalents are incorporated herein as if they were individually set forth.

- 15 One preferred form of the invention will now be described with reference to the accompanying drawings in which,

FIGURE 1 is a plan view of a series of bobbins as mounted on a former,

FIGURE 2 is an elevation view of the same bobbins

FIGURE 3 is an end view of a bobbin

- 20 With reference to **Figure 1**, a coil for a toroidally wound machine is manufactured as a series of bobbins which comprise two phase windings starting at 10, 11 and ending at 12, 13. For winding the coils are mounted on a rectangular former. The winder preferably has a multi-wire winding head and winds bobbins for each phase simultaneously.

- 25 With reference to **Figure 2**, the drawing shows how having filled one pair of bobbins the wire is routed to the next pair by shifting the former in relation to the winding heads sufficiently to slot the wire into the inter-bobbin space at 14, rotating the former a half turn

and translating it so that the winding heads feed into the next pair of bobbins. This process continues until all of the bobbins are filled.

- Alternative methods to the half turn between bobbins are possible to maintain tension on the last winding turn in the bobbin. For example one or more turns of wire may be wrapped
5 round a pin formed into the bobbin edge.

The bobbins preferably have an external shelf 15 on which the wire being routed between bobbins lays for support. The shelf, in combination with the tapered edges on one side of the bobbin, assists in providing a stable coil configuration and a good packing factor when the bobbins are placed in a curved path on the toroid in the machine.

- 10 Where the coils are wound for more than two phases the wires for differing phases may be offset in separate bobbin cheek notches while bridging across adjacent bobbins, and any underwires may be recessed into the bobbins.

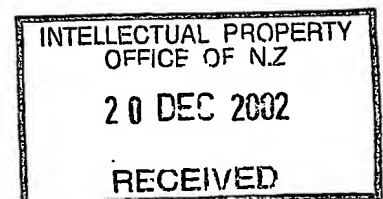
The end wires of the phases may be secured to the terminations on the machine without requiring any subsidiary terminations on the coil assembly.

- 15 Thus it can be seen that at least the preferred form of the invention provides a toroidally wound electrodynamic machine combining the advantages of being able to wind the toroidal electrical coils while arranged in a straight line, without the added complexity of having to electrically join the coils during machine construction.

20 **PIPERS**

Attorneys for:

Wellington Drive Technologies Ltd



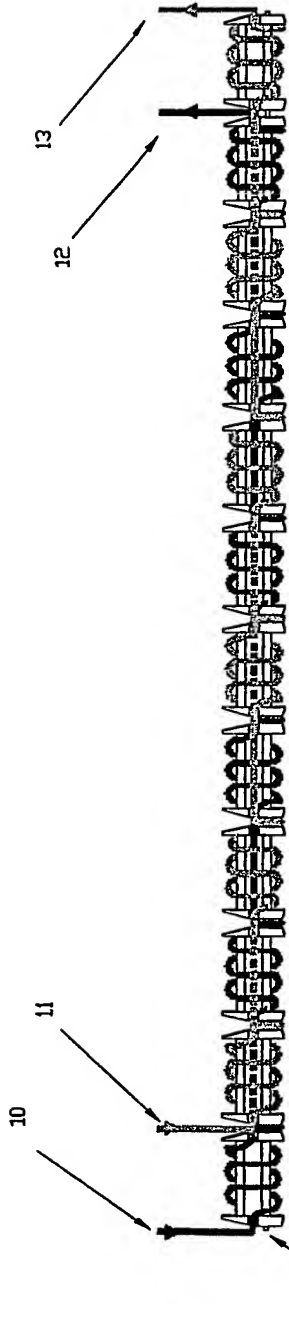


Fig 1

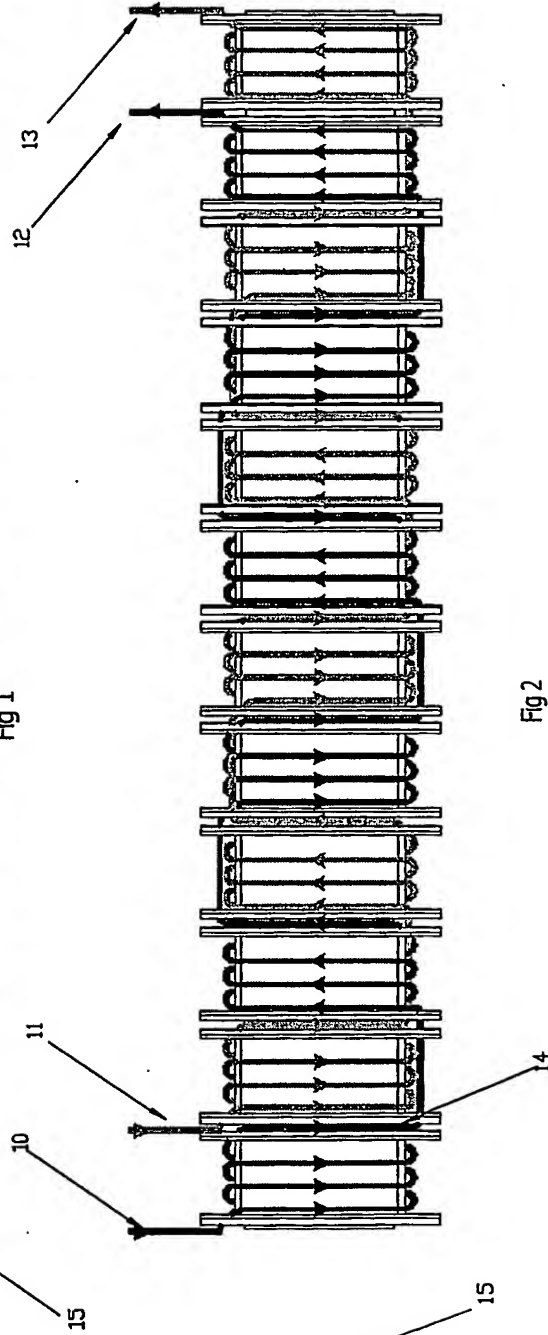


Fig 2

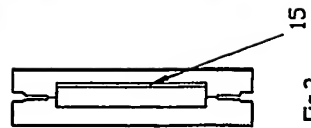


Fig 3